HEALTH & WELFARE EFFECTS OF

AIR QUALITY CRITERIA POLLUTANTS

OFFICE OF AIR QUALITY
PLANNING AND STANDARDS

U.S. ENVIRONMENTAL PROTECTION AGENCY

HEALTH & WELFARE EFFECTS OF AIR QUALITY CRITERIA POLLUTANTS

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NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Primary Standard(s)	Averaging Time(s)	Secondary Std(s).
Carbon Monoxide	9 ppm (10 mg/m^3) 35 ppm (40 mg/m^3)	8-hour[1] 1-hour[1]	None
Lead	1.5 ug/m^3	Quarterly Average	Same as Primary
Nitrogen Dioxide	0.053 ppm (100 ug/m^3)	Annual (Arithmetic Mean)	Same as Primary
Particulate Matter (PM_{10})	50 ug/m^3 150 ug/m^3	Annual[2] (Arith. Mean) 24-hour[3]	Same as Primary
Particulate Matter ($PM_{2.5}$)	15 ug/m^3 65 ug/m^3	Annual[4] (Arith. Mean) 24-hour[5]	
Ozone	0.08 ppm	8-hour[6]	Same as Primary
Sulfur Oxides	0.03 ppm 0.14 ppm ----------	Annual (Arith. Mean) 24-hour[1] 3-hour[1]	---------- ---------- 0.5 ppm (1300 ug/m^3

[1] Not to be exceeded more than once per year.

[2] To attain this standard, the 3-year average of the annual arithmetic mean PM_{10} concentrations at each monitor within an area must not exceed 50 ug/m^3.

[3] To attain this standard, the 3-year average of the 99th percentile of 24-hour PM_{10} concentrations at each monitor within an area must not exceed 150 ug/m^3.

[4] To attain this standard, the 3-year average of the annual arithmetic mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15 ug/m^3.

[5] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 65 ug/m.

[6] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

AIR QUALITY CRITERIA POLLUTANTS AND NATIONAL AMBIENT AIR QUALITY STANDARDS

- FOR A POLLUTANT TO BE CONSIDERED AN AIR QUALITY CRITERIA POLLUTANT

  -- IT MUST BE UBIQUITOUS IN THE AMBIENT AIR,

  -- IT MUST CAUSE HEALTH AND/OR WELFARE EFFECTS OF CONCERN AT LEVELS WHICH HAVE BEEN MEASURED IN THE AMBIENT AIR, AND

  -- IT MUST BE MEASURED IN AMBIENT AIR AT ELEVATED LEVELS, IN PART, CAUSED BY HUMAN ACTIVITY.

- THERE ARE SIX NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

  -- CARBON MONOXIDE

  -- LEAD

  -- NITROGEN DIOXIDE

  -- OZONE

  -- PARTICULATE MATTER

  -- SULFUR DIOXIDE

CARBON MONOXIDE (CO)

- **SOURCES OF EXPOSURE**

  -- MOTOR VEHICLES
  -- GAS AND WOOD STOVES
  -- FAULTY HEATERS
  -- PASSIVE SMOKING

- **HEALTH EFFECTS OF GREATEST CONCERN**

  -- REDUCED TIME TO ONSET OF ANGINA
  -- FATIGUE, NAUSEA
  -- IMPAIRED VIGILANCE
  -- REDUCED WORK CAPACITY
  -- POSSIBLE FETAL DEVELOPMENTAL EFFECTS

- **MAJOR ISSUES**

  -- EVIDENCE SUGGESTS EXPOSURE TO CARBON MONOXIDE EXACERBATES SEVERITY AND DURATION OF ANGINA PECTORIS ATTACKS
  -- TOTAL EXPOSURE INCLUDES EXPOSURE TO EMISSIONS OF MANY INDOOR SOURCES
  -- EXTENT OF FETAL EFFECTS IS STILL UNKNOWN
  -- EXISTING NAAQS RETAINED IN 1994
  -- NEW EVIDENCE OF ASSOCIATION BETWEEN AMBIENT LEVELS AND INCREASED RISK OF MORTALITY FROM CARDIOVASCULAR EFFECTS
  -- FEW NONATTAINMENT AREAS IN U.S.

LEAD (Pb)

- **SOURCES OF EXPOSURE**

  -- PAINT IN OLDER HOMES
  -- SMELTERS
  -- CONTAMINATED SOIL
  -- DRINKING WATER
  -- CERAMIC GLAZING

- **HEALTH EFFECTS OF GREATEST CONCERN**

  -- NEUROBEHAVIORAL ALTERATIONS (E.G., IQ, ATTENTIONAL, AND HEARING DEFICITS)
  -- METABOLIC ALTERATIONS
  -- HEMATOLOGICAL ALTERATION (E.G., ANEMIA)
  -- INCREASED BLOOD PRESSURE IN ADULTS

- **MAJOR ISSUES**

  -- MORE SEVERE EFFECTS HAVE BEEN REPORTED IN CHILDREN WITH NUTRITIONAL DEFICIENCIES
  -- GUIDELINES ISSUED BY CENTERS FOR DISEASE CONTROL SUGGEST MANY CHILDREN HAVE BLOOD LEAD LEVELS OF CONCERN
  -- REMOVAL OF LEAD PAINT AND CONTAMINATED SOIL SHOULD REDUCE MAJOR REMAINING SOURCES OF LEAD EXPOSURE

NITROGEN DIOXIDE (NO_2)

- **SOURCES OF EXPOSURE**

  -- MOTOR VEHICLES
  -- POWER PLANTS AND INDUSTRIAL BOILERS
  -- GAS STOVES AND OVENS
  -- UNVENTED SPACE HEATERS

- **HEALTH EFFECTS OF GREATEST CONCERN**

  -- INCREASED AIRWAY RESPONSIVENESS AND LUNG FUNCTION DECREMENTS IN ASTHMATICS
  -- SYMPTOMS (E.G., COUGH, THROAT IRRITATION)
  -- POSSIBLE LUNG STRUCTURE DAMAGE FOR LONG-TERM, HIGH-LEVEL EXPOSURES
  -- INCREASED RISK OF RESPIRATORY ILLNESS

- **MAJOR ISSUES**

  -- CHILDREN LIVING IN HOMES WITH GAS STOVES APPEAR TO BE AT INCREASED RISK OF DEVELOPING RESPIRATORY ILLNESS
  -- INDOOR EXPOSURE IS AN IMPORTANT PART OF TOTAL HUMAN EXPOSURE
  -- NAAQS WAS RETAINED IN 1996
  -- THERE ARE NO NONATTAINMENT AREAS BUT CONTROL OF NITROGEN OXIDES IS IMPORTANT IN THE CONTROL OF AMBIENT OZONE LEVELS

OZONE (O_3)

- **SOURCES OF EXPOSURE**

  -- OZONE IS FORMED IN THE ATMOSPHERE AS A REACTION PRODUCT OF VOLATILE ORGANIC COMPOUNDS AND NITROGEN OXIDES EMITTED BY A VARIETY OF SOURCES

    -- MOTOR VEHICLES
    -- POWER PLANTS AND INDUSTRIAL BOILERS
    -- TOXIC WASTE AND LANDFILL SITE EMISSIONS
    -- NUMEROUS SMALL SOURCES (E.G., DRY CLEANERS, LAWN MOWERS, SOLVENTS)

- HEALTH EFFECTS OF GREATEST CONCERN

  -- ACUTE LUNG FUNCTION IMPAIRMENT FOLLOWING OZONE EXPOSURES LASTING 1 TO 2 HOURS
  -- EXACERBATED LUNG FUNCTION IMPAIRMENT FOLLOWING MULTI-HOUR EXPOSURES TO OZONE
  -- SYMPTOMATIC EFFECTS (E.G., COUGH, NAUSEA, THROAT IRRITATION, CHEST PAIN)
  -- INCREASED SUSCEPTIBILITY TO LUNG INFECTION
  -- STRUCTURAL DAMAGE REPORTED IN ANIMALS FOLLOWING CHRONIC EXPOSURE TO OZONE
  -- INCREASED RESPIRATORY HOSPITAL ADMISSIONS IN AREAS WITH HIGH OZONE LEVELS
  -- INCREASED AIRWAY RESPONSIVENESS IN ASTHMATIC INDIVIDUALS

OZONE (O_3) (continued)

- **MAJOR ISSUES**

  -- OZONE CONCENTRATION, EXERTION LEVEL, AND DURATION OF EXPOSURE ARE MAJOR DETERMINANTS OF RESPIRATORY HEALTH EFFECTS

  -- PROLONGED EXPOSURES TO OZONE CAN SUBSTANTIALLY INCREASE HEALTH EFFECTS, EVEN AT MODERATE LEVELS OF EXERTION

  -- OZONE-INDUCED RESPIRATORY INFLAMMATION MAY AGGRAVATE ASTHMA AND CONTRIBUTE TO INCREASED RESPIRATORY HOSPITAL ADMISSIONS; HOWEVER, THERE IS LARGE UNCERTAINTY ABOUT THE EXTENT TO WHICH OZONE CONTRIBUTES

  -- ALTHOUGH REPEATED EXPOSURES TO OZONE OVER PERIOD OF MONTHS TO YEARS CAUSES STRUCTURAL DAMAGE OF LUNG TISSUE IN EXPERIMENTAL ANIMALS, QUANTITATIVE USE OF THESE DATA IS LIMITED BY UNCERTAINTIES IN EXTRAPOLATING FROM ANIMAL DATA TO HUMAN HEALTH EFFECTS

  -- A NEW 8-HOUR OZONE NAAQS WAS SET ON JULY 18, 1997, BASED ON MANY HUMAN STUDIES SHOWING THAT HEALTH EFFECTS OCCUR AT LEVELS BELOW THE PREVIOUS STANDARD LEVEL FOR PEOPLE ENGAGED IN PROLONGED, MODERATE ACTIVITY

  -- RECENT STUDIES SUGGEST ASSOCIATION BETWEEN OZONE AND PREMATURE MORTALITY

PARTICULATE MATTER (PM)

C SOURCES OF EXPOSURE

-- FOSSIL FUEL COMBUSTION
-- FUGITIVE DUST
-- MOTOR VEHICLES
-- WOODSTOVES
-- PASSIVE SMOKING

C HEALTH EFFECTS OF GREATEST CONCERN

-- PREMATURE MORTALITY IN ELDERLY AND IN INDIVIDUALS WITH RESPIRATORY ILLNESS
-- REDUCTION IN LUNG FUNCTION
-- INCREASED RESPIRATORY SYMPTOMS/ILLNESS
-- INCREASED RESPIRATORY HOSPITAL ADMISSIONS

C MAJOR ISSUES

-- NUMEROUS PUBLISHED STUDIES PROVIDE EVIDENCE OF INCREASED MORTALITY AT LEVELS REPORTED IN MANY CITIES THROUGHOUT THE U.S.
-- PM_{10} NAAQS SET IN 1987 TO CONTROL PARTICLES < 10 MICRONS; FINE PARTICLES OF GREATER CONCERN
-- REVIEW OF NAAQS COMPLETED ON JULY 18, 1997, AND FINE PARTICLE STANDARD WAS SET TO CONTROL AMBIENT LEVELS OF PARTICLES SMALLER THAN 2.5 MICRONS
-- REVIEW OF STANDARDS IS NOW UNDERWAY

SULFUR DIOXIDE (SO_2)

C SOURCES OF EXPOSURE

-- LARGE UTILITY AND INDUSTRIAL BOILERS
-- SMELTERS
-- NUMEROUS SMALL COAL AND OIL COMBUSTORS

C HEALTH EFFECTS OF GREATEST CONCERN

-- BRONCHOCONSTRICTION INCREASED IN ASTHMATICS TO AN EXTENT THAT MAY BE PERCEIVED AS A MILD ASTHMA ATTACK
-- RESPIRATORY SYMPTOMS (E.G., WHEEZE, CHEST TIGHTNESS) IN ASTHMATICS

C MAJOR ISSUES

-- SHORT-TERM EXPOSURES (3 TO 10 MINUTES) PRODUCE EFFECTS IN EXERCISING ASTHMATICS
-- ALTHOUGH THERE CONTINUE TO BE CASES OF SHORT-TERM EXPOSURE TO HIGH LEVELS OF SULFUR DIOXIDE IN THE AMBIENT AIR, THE NONATTAINMENT PROBLEM HAS BEEN RESOLVED
-- SULFUR DIOXIDE NAAQS WAS UNCHANGED IN RECENT REVIEW COMPLETED IN 1996
-- INTERVENTION LEVEL PROGRAM HAS BEEN DESIGNED TO REDUCE SHORT-TERM HIGH LEVEL EXPOSURES
– AFTER REMAND, DECISION ON NAAQS IS PENDING

WELFARE EFFECTS

THE FOLLOWING WELFARE EFFECTS (I.E., VISIBILITY IMPAIRMENT, DAMAGE TO AGRICULTURAL CROPS, ECOSYSTEMS, AND MATERIALS) HAVE BEEN ATTRIBUTED TO AIR QUALITY CRITERIA POLLUTANTS:

- **OZONE**
  - AGRICULTURAL CROP DAMAGE
  - IMPAIRED GROWTH AND FOLIAR DAMAGE TO TREES
  - MATERIALS DAMAGE

- **PARTICULATE MATTER**
  - VISIBILITY IMPAIRMENT
  - SOILING AND MATERIALS DAMAGE

- **NITROGEN DIOXIDE**
  - NITROGEN LOADING OF ECOSYSTEMS
  - PRECURSOR TO ACIDIC PRECIPITATION

- **SULFUR DIOXIDE**
  - MATERIALS DAMAGE
  - PRECURSOR TO ACIDIC PRECIPITATION